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NPIC/TSSG/DED-1667-69
17 June 1969

MEMORANDUM FOR : Chief, Technical Services & Support Group, NPIC

25X1 SUBJECT : [redacted] Digital Image Construction

REFERENCE : (a) Executive Director, NPIC Memorandum on Data Corporation-Digital Image Construction, dated 11 February 1969

25X1 (b) [redacted] Report - Image Enhancement, 28 February 1968

(c) Memo to Executive Director, NPIC, Subject: "DIR Task Force Report," dated 20 November 1968

(d) Memo to Executive Director, NPIC, Subject: "Data Corporation," dated 14 March 1969

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1. Accompanied by [redacted]
25X1 [redacted], I visited [redacted] 25X1
25X1 [redacted] on 26 and 27 March 1969, respectively. The digital image construction program of both companies was reviewed to determine the NPIC application potential, present and future.

2. Summary of Visit to [redacted] 25X1

25X1 a. The [redacted] representatives, [redacted] 25X1 summarized a program of digital and analog image enhancement research begun in July 1967 and oriented toward determining general technical requirements, capabilities, and limitations. The [redacted] system employs a modified, commercially available [redacted] drum scanner input/output device and an A-D converter to permit digitizing of B&W or color film images. A comprehensive software library has been developed to perform image manipulation experiments. IBM 360/75 and 360/50 computers are employed to handle the large data volume relatively rapidly. The output, or final image, is on photographic film or paper. For color, three separate output scans are required to produce a negative from which color transparencies or prints can subsequently be made by conventional means.

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b. In its present research configuration, the [redacted] system scans one square inch of film (input or output) in 16 minutes. Allowing for B&W film developing time and depending on the amount of computer manipulation performed, a final 4 X 5 image produced from a 1-inch area of the original negative, would require 6-10 hours. For color, this period is increased by more than a factor of 3.

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25X1 c. [redacted] is continuing work on the input/output device and the debugging of associated software, in pursuit of propietary goals for both B&W and color. The maximum system output (B&W) resolution of 40 scan lines per mm was designed and is suitable for graphic arts and commerical photographic applications. The system is not intended to compete with the [redacted] 25X1
25X1 [redacted] equipment. No experiments have been performed to determine the NPIC image interpretability value or potential of this system.

3. Summary of Visit to [redacted] 25X1

25X1 a. [redacted] representatives, [redacted] President, 25X1
25X1 [redacted] Program Manager, discussed and demonstrated portions of a precise digital image construction system. Topics included the input device, present and potential software capabilities, the non-photographic, direct positive hard copy output device, and examples of current results. The proposal submitted to NPIC in February 1969 was also reviewed.

b. The input scanning device is a modified version of the [redacted] 25X1 microdensitometer of the type now in use by APSD/TSSG. Designed to minimize loss of information during scanning, it provides a minimum scan-line increment of 0.25 microns, a point repositioning accuracy of 0.02 microns, and a corresponding density precision of 0.01 units. A program, in the amount of
25X1 [redacted] was proposed by [redacted] to convert the NPIC microdensitometer to meet these standards. However, at least two of the proposed modifications; i.e., the conversion of the reversing switches and increase in scanner speed, are already programmed or completed (on another contract), and [redacted] 25X1 was so informed. The remaining modifications; i.e., the inclusion of a hydraulic drive system to improve scanning accuracy and precision, the electronic timing and step-over device, and the improved optical system, would be necessary to convert the NPIC instrument. The consequent changes in cost data were not available and would require further analysis by [redacted] The modifi- 25X1 cations would not, in themselves, limit the capability of the NPIC micro-D to perform image analysis measurements; however, the long input scanning time would limit instrument avaliablity if used primarily for image processing. For example, using a 1 micron scanning aperture, a one inch square area requires four weeks (24 hr/day), and an area the size of the Pentagon [redacted] requires 25X1 some 100 hours of scanning time. Obviously this limits the tasks this equipment can perform.

c. Software has been developed to improve tonal quality, image sharpness, and to correct for geometric and brightness distortions. Other variations are possible as specifications are developed. Existing programs are written for the IBM 360/40. The value of improved information yield to NPIC has not been determined.

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d. The prototype output or display device produces a 40" X 60" non-photographic positive B&W paper print in two hours. Color is feasible but not yet practical in time or quality. An improved output device, yielding 40" X 60" prints of the same quality in 15' is now under construction (estimated availability, 1970). The prototype display device, employs a single ink-jet applicator whose output is controlled by the computer. The ink is laid down so as to permit detail rendition and a tonal scale exceeding those normally achieved with photographic printing. The suitability of the output device for PI purposes has not been determined, but warrents consideration. No
25X1 tests are planned by [redacted] As presently designed, a separate printer/output device is required for each print size.

e. Other types of input/output devices, e.g., a video line scanner, could be employed to add versatility when requirements did not demand the extreme resolution and consequent slow precision raster scanning.

25X1 4. Conclusions - [redacted]

a. The software developed by [redacted] would be of great value to an 25X1
image manipulation program in both the research and operational phases.

b. The input/output scanner viewed in terms of NPIC needs is primarily a research tool. It is not, nor was it intended to be, a component in a real-time or near real time configuration, an on-line operation, or other production type application.

25X1 5. Conclusions - [redacted]

a. The long-range program proposed by [redacted] does not 25X1
warrant NPIC support at this time. An on-line operational capability for interpretation purposes does not appear feasible in the near future. The slow input raster scanning rates for digital systems is the limiting factor. Requirements for high resolution and relatively large areas increase the time factor geometrically.

b. Special purpose applications are possible within the next two years; e.g., characteristic curve manipulation, edge enhancement, and image
25X1 analysis. Application of the [redacted] system to mensuration problems holds more immediate promise, though limiting parameters must first be determined.

25X1 c. The claim, by [redacted] of attaining scanning spot sizes of less than 1 micron is not supported by the physics. A limit of 2-5 microns may be possible, though this is the dimension range quoted for laser scanners.

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d. Use of the [redacted] output device with other types of scanners; e.g., CRT, laser beam should be considered. 25X1

e. Routine use of the [redacted] display unit in the publications area would increase printing time substantially over present methods. Some special purpose applications are possible; e.g., expand gray scale in small dark areas not otherwise printable. The value of this option to NPIC has to be determined by experiment and cost considerations. 25X1

f. The proposal on hand from [redacted] will have to be revised since some of the changes recommended for the NPIC micro-scanner have already been made. In addition, it should be ammended to include sufficient technical operating data to permit evaluation. As an alternative, [redacted] could submit an unsolicited proposal designed to test the value of their output product to NPIC. 25X1 25X1 25X1

g. The hardware components of the [redacted] digital systems are not compatible with the NPIC ATR program due to target size and time limitations; however, the computer employed for digital construction would be compatible with one employed in an ATR program. The target recognition problem has not been addressed by either firm.

6. Discussion

a. It is evident from the discussions held on this trip that image-manipulation as an aid to the PI has great potential but has not received the attention required to determine specific capabilities and limitations. The operational time requirements alone will restrict the application of raster scanning techniques. Other methods; e.g., optical data processing offer a solution to the time problem but do not have the flexibility inherent with the use of the computer. 25X1

b. It is reasonable to consider a combination of the optical and digital approaches. Several companies have considered this [redacted] but only to the drawing board stage.

c. Before we can answer questions like, what will a given system or capability buy us, the NPIC goals and objectives need to be considered. In accomplishing this one must realize the state-of-the-art is such that complete automation is beyond us in the forseeable future. The PI will be a key interactive element in any image manipulation system.

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7. Future Plan of Action

May - July 1969

a. Conduct a survey of organizations engaged in image processing R&D to determine the technological state-of-the-art with particular emphasis on:

(1) The extent to which the digital-optical analog hybrid concept is relavent to NPIC requirements

(2) Laser Scanners

(3) Computer Requirements

(4) Quality of images produced

(5) Costs

25X1 b. Recommend preliminary programs as appropriate; e.g., any proposal from [redacted] designed to test feasibility of their output device as applied to NPIC operations.

August - September 1969

Develop a comprehensive image processing program consistent with NPIC objectives and the technological state-of-the-art.

25X1 [redacted]

Chief, Development & Engineering Division, TSSG

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